In Vivo Human Somitogenesis Guides Somite Development from hPSCs.

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Public Summary:
Somites are precursor populations of cells that form during embryonic development and turn into unique cell and tissue types, such as skeletal muscles, bones, and cartilage of the vertebrae. We developed an efficient way to make somite cells from human induced stem cells in culture. Additionally, these cells could then generate bone precursor cells such as skeletal myocytes, osteocytes, and chondrocytes. This work improves our understanding of how human somites grow and generate muscles, bones and cartilage and may enhance our ability to treat diseases that affect these tissues.

Scientific Abstract:
Somites form during embryonic development and give rise to unique cell and tissue types, such as skeletal muscles and bones and cartilage of the vertebrae. Using somitogenesis-stage human embryos, we performed transcriptomic profiling of human presomitic mesoderm as well as nascent and developed somites. In addition to conserved pathways such as WNT-beta-catenin, we also identified BMP and transforming growth factor beta (TGF-beta) signaling as major regulators unique to human somitogenesis. This information enabled us to develop an efficient protocol to derive somite cells in vitro from human pluripotent stem cells (hPSCs). Importantly, the in-vitro-differentiating cells progressively expressed markers of the distinct developmental stages that are known to occur during in vivo somitogenesis. Furthermore, when subjected to lineage-specific differentiation conditions, the hPSC-derived somite cells were multipotent in generating somite derivatives, including skeletal myocytes, osteocytes, and chondrocytes. This work improves our understanding of human somitogenesis and may enhance our ability to treat diseases affecting somite derivatives.